

WHAT IS CLAIMED IS:

1. A resonator comprising:

a multi-layer substrate having an upper and lower surface, and including at least two conductor layers which include at least two grounding conductor layers and a plurality of dielectric layers, one of the at least two grounding conductor layers being disposed on the lower surface of the multi-layer substrate;

a strip line disposed between the at least two grounding conductor layers;

a microstrip line disposed on the upper surface of said multi-layer substrate; and

a through hole formed in said dielectric layers to connect said strip line to said microstrip line;

wherein at least a portion of the one of the at least two conductor layers that is closest to said microstrip line and faces the microstrip line is omitted.

2. A resonator according to Claim 1, wherein said portion of said one of the at least two conductor layers that is omitted is disposed inside said multi-layer substrate and is arranged such that said grounding conductor layer disposed on the lower surface of said multilayer

substrate faces said microstrip line.

3. A resonator according to Claim 1, wherein said portion of said one of the at least two conductor layers that is omitted defines an opening in said one of the at least two conductor layers.

4. A resonator according to Claim 3, wherein said opening has one of a substantially rectangular shape and a substantially square shape.

5. A resonator according to Claim 1, wherein said strip line has a substantially U-shaped configuration.

6. A resonator according to Claim 1, wherein the resonator comprises only one said strip line.

7. A resonator according to Claim 1, wherein the resonator comprises only one said microstrip line.

8. A resonator comprising:  
a multi-layer substrate having an upper and lower surface, and including at least two conductor layers which include at least two grounding conductor layers and a plurality of dielectric layers, one of the at least two

grounding conductor layers being disposed on the lower surface of the multi-layer substrate, and one of the at least two conductor layers that is closest to said microstrip line and faces the microstrip line has an opening formed therein;

a strip line disposed between the at least two grounding conductor layers;

a microstrip line disposed on the upper surface of said multi-layer substrate; and

a through hole formed in said dielectric layers to connect said strip line to said microstrip line.

9. A resonator according to Claim 8, wherein said opening is arranged such that said grounding conductor layer disposed on the lower surface of said multi-layer substrate faces said microstrip line.

10. A resonator according to Claim 8, wherein said opening has one of a substantially rectangular shape and a substantially square shape.

11. A resonator according to Claim 8, wherein said strip line has a substantially U-shaped configuration.

12. A resonator according to Claim 8, wherein the

resonator comprises only one said strip line.

13. A resonator according to Claim 8, wherein the resonator comprises only one said microstrip line.

14. A voltage controlled oscillator comprising:  
a resonator including:

a multi-layer substrate having an upper and lower surface, and including at least two conductor layers which include at least two grounding conductor layers and a plurality of dielectric layers, one of the at least two grounding conductor layers being disposed on the lower surface of the multi-layer substrate;

a strip line disposed between the at least two grounding conductor layers;

a microstrip line disposed on the upper surface of said multi-layer substrate; and

a through hole formed in said dielectric layers to connect said strip line to said microstrip line;

wherein at least a portion of the one of the at least two conductor layers that is closest to said microstrip line and faces the microstrip line is omitted; and

a plurality of electronic component elements disposed on the upper surface of the multi-layer substrate and

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arranged to define a circuit.

15. The voltage controlled oscillator according to claim 14, wherein the plurality of the electronic component elements and the resonator are electrically connected to each other.

16. The voltage controlled oscillator according to claim 14, wherein said portion of said one of the at least two conductor layers that is omitted is disposed inside said multi-layer substrate and is arranged such that said grounding conductor layer disposed on the lower surface of said multi-layer substrate faces said microstrip line.

17. The voltage controlled oscillator according to claim 14, wherein said portion of said one of the at least two conductor layers that is omitted defines an opening in said one of the at least two conductor layers.

18. The voltage controlled oscillator according to claim 17, wherein said opening has one of a substantially rectangular shape and a substantially square shape.

19. The voltage controlled oscillator according to claim 14, wherein said strip line has a substantially U-

shaped configuration.

20. The voltage controlled oscillator according to claim 14, wherein the voltage controlled oscillator comprises only one said strip line.

21. The voltage controlled oscillator according to claim 14, wherein the voltage controlled oscillator comprises only one said microstrip line.

and the other two were very much smaller.